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Application No.: 10/800,230

Docket No.: TOW-067

REMARKS

Applicants amend claims 1 and 4. Claims 1-7 are pending, of which claims 1 and 4 are independent. No new matter has been introduced. Support for the claim amendments can be found in Applicants' Specification at page 8, lines 9-11. Applicants respectfully submit that the pending claims define over the art of record.

Objection to the Specification

The Specification is objected to because the word "efficiently," at page 12, line 12, should not be hyphenated. Applicants amend the Specification to correct the above misspelling. Applicants respectfully request the Examiner to reconsider and to withdraw the objection to the Specification.

The Claimed Invention

The claimed invention is generally directed to a fuel gas production apparatus including a reforming mechanism and a PSA mechanism directly connected to the reforming mechanism. The reforming mechanism uses an auto-thermal reforming system for reforming a fuel to obtain a reformed gas. Hydrogen containing fuel, steam and oxygen induce oxidation reaction and reforming reaction simultaneously in the reforming mechanism. The PSA mechanism removes impurities from the reformed gas to produce a hydrogen-rich pure fuel gas.

In conventional steam reforming systems, only an endothermic reaction occurs and an external heating mechanism is required. In contrast, an external heating mechanism is not used in the auto-thermal reforming mechanism of the claimed invention. Thus, the auto-thermal reforming system is smaller and less time is required for warming up the system to start production of the fuel gas.

Rejection of Claims 1-7 under 35 U.S.C. §102**The Dickman Reference**

Claims 1, 3, 4 and 6 are rejected under 35 U.S.C. §102(b) as being anticipated by United States Patent Publication Number 20030008186 to Dickman et al (hereafter "Dickman"). Claim

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7 is rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over the Dickman reference. Applicants respectfully submit that the Dickman reference does not disclose “a reforming mechanism *including an auto-thermal reforming (ATR) system* for reforming the hydrogen-containing fuel to obtain a reformed gas,” as recited in amended independent claims 1 and 4.

The Dickman reference is generally directed to a feedstock mixing apparatus for fuel processing systems. The fuel processing system includes one or more fuel processors adapted to produce a product hydrogen stream from a feed stream containing water and a carbon-containing feedstock. The fuel processing system may also include one or more fuel cell stacks that are adapted to produce an electric current from the product hydrogen stream produced by the fuel processing system. See Dickman, abstract.

Applicants respectfully submit that the Dickman reference does not disclose “a reforming mechanism *including an auto-thermal reforming (ATR) system* for reforming the hydrogen-containing fuel to obtain a reformed gas,” as recited in claims 1 and 4. The Dickman reference discusses a steam reformer as an example of a suitable fuel processor 12. See Dickman, paragraph [0094]. Additionally, in connection with Figure 3, the Dickman reference states that fuel processor 12 may include a heating assembly 44 to heat fuel processor 12 to a sufficient operating temperature. See Dickman, paragraph [0026]. As illustrated in Figure 3, heating assembly 44 is separate from and supplies heat to hydrogen-producing region 32. The externally-supplied heat allows hydrogen-producing region 32 to produce a stream 36 containing hydrogen gas from feed stream 16. See Dickman, paragraphs [0024], [0026]. Thus, in the Dickman steam reformer, heat is supplied externally to the hydrogen-producing region to cause an endothermic reaction. The Dickman reference fails to disclose that the reformer uses an auto-thermal reforming system.

In contrast, claims 1 and 4 require a reforming mechanism that uses an auto-thermal reforming (ATR) system. The auto-thermal reforming system of the claimed invention does not use externally-supplied heat and has a completely different structure from a steam reformer that relies on externally-supplied heat. In fact, the Background section of Applicants’ Specification discusses a steam reformer similar to the Dickman steam reformer as prior art. See

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Specification, page 6, lines 3-9. The Dickman reference fails to disclose "a reforming mechanism *including an auto-thermal reforming (ATR) system* for reforming the hydrogen-containing fuel to obtain a reformed gas," as recited in claims 1 and 4.

In light of the foregoing arguments, Applicants respectfully submit that the Dickman reference does not disclose each and every element of independent claims 1 and 4. Applicants respectfully request that the 35 U.S.C. §102(b) rejection of claims 1 and 4 in view of the Dickman reference be withdrawn. Reconsideration and allowance of claims 1 and 4 is requested in view of the above remarks.

Claim 3 depends upon claim 1 and adds separate and patentable limitations to claim 1. Claims 6 and 7 depend upon claim 4 and add separate and patentable limitations to claim 4. As such, Applicants respectfully submit that the dependent claims also define over the art of record.

The Burch Reference

Claims 1-6 are rejected under 35 U.S.C. §102(e) as being anticipated by United States Patent Publication Number 20040101750 to Burch (hereafter "Burch"). Applicants respectfully submit that the Burch reference fails to disclose "a PSA mechanism *directly connected* to said reforming mechanism for removing impurities from said reformed gas to refine said reformed gas into said fuel gas," as recited in amended independent claims 1 and 4. As stated in Applicants' Specification at page 5, lines 16-18, "*directly connected*" recited in claims 1 and 4 means that no mechanisms for inducing chemical reaction are provided between the reforming mechanism and the PSA mechanism.

The Burch reference is generally directed to a set of fuel cell system heat exchangers that have been modified to incorporate thermal-to-electric devices. These devices convert a portion of the thermal energy flowing through each heat exchanger to electric energy. The Burch reference is also directed to methods for operating the fuel cell system. See Burch, abstract.

Applicants respectfully submit that the Burch reference does not disclose "a PSA mechanism *directly connected* to said reforming mechanism for removing impurities from said reformed gas to refine said reformed gas into said fuel gas," as recited in claims 1 and 4. As

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illustrated in Figures 2 and 3 of the Burch reference, auto-thermal reformer 32 is connected to CO-reduction reactor 37, such as first and second stage water gas shifts 36 and 38, respectively. See Burch, paragraph [0027]. In CO-reduction reactors, with water supplied thereto, a chemical shift reaction is induced which produces a hydrogen-containing gas. Such a CO-reduction reactor is discussed in the Background section of Applicants' Specification as comparative related art. Water gas shifts 36 and 38 in the Burch reference correspond to CO shift reactor 4 of system 1 as discussed in Applicants' Background section. See Specification, page 2, line 25 – page 4, line 23. In the Burch reference, CO-reduction reactor 37, including water gas shifts 36 and 38 are, in turn, connected to pressure-swing adsorption (PSA) device 52. See Burch, Figure 3. Thus, in the Burch reference, the reformer is connected to the PSA through the water gas shifts of the CO-reduction reactor which induce a chemical reaction.

In contrast, claims 1 and 4 require that the PSA mechanism be directly connected to the reforming mechanism. As stated in Applicants' Specification, no mechanisms for inducing chemical reaction are provided between the reforming mechanism and the PSA mechanism in the claimed invention. See Specification, page 5, lines 16-21. The Burch reference fails to disclose "a PSA mechanism *directly connected* to said reforming mechanism for removing impurities from said reformed gas to refine said reformed gas into said fuel gas," as recited in claims 1 and 4.

In light of the foregoing arguments, Applicants respectfully submit that the Burch reference does not disclose each and every element of independent claims 1 and 4. Applicants respectfully request that the 35 U.S.C. §102(e) rejection of claims 1 and 4 in view of the Burch reference be withdrawn. Reconsideration and allowance of claims 1 and 4 is requested in view of the above remarks.

Claims 2 and 3 depend upon claim 1 and add separate and patentable limitations to claim 1. Claims 5 and 6 depend upon claim 4 and add separate and patentable limitations to claim 4. As such, Applicants respectfully submit that the dependent claims also define over the art of record.

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Rejection of Claim 7 under 35 U.S.C. §103**The Dickman Reference**

Claim 7 is rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over the Dickman reference. Claim 7 depends upon independent claim 4. In view of the above arguments, Applicants respectfully submit that the Dickman reference fails to teach or suggest “a reforming mechanism *including an auto-thermal reforming (ATR) system* for reforming the hydrogen-containing fuel to obtain a reformed gas,” as recited in amended independent claim 4.

In light of the foregoing arguments, Applicants respectfully submit that the Dickman reference does not teach or suggest each and every element of independent claim 4. Claim 7 depends upon claim 4 and adds separate and patentable limitations to claim 4. As such, for this and the reasons set forth above, Applicants respectfully submit that the dependent claim defines over the art of record.

The Hirata Reference

Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over the Burch reference, as applied to claim 4 above, and further in view of United States Patent Publication Number 20020031458 A1 to Hirata (hereafter “Hirata”). Claim 7 depends upon independent claim 4. In view of the above arguments, Applicants respectfully submit that the Burch reference does not teach or suggest “a PSA mechanism *directly connected* to said reforming mechanism for removing impurities from said reformed gas to refine said reformed gas into said fuel gas,” as recited in claim 4. Thus, the Burch reference fails to teach or suggest each and every element of amended independent claim 4. The addition of the Hirata reference fails to cure this deficiency.

The Hirata reference is generally directed to a reformer including three reforming reaction units having catalyst layers. A supply of crude fuel gas fed to the reformer successively passes through the catalyst layers to be subjected to reforming reactions and converted to a hydrogen-rich gaseous fuel. See Hirata, abstract.

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Applicants respectfully submit that the Hirata reference also does not teach or suggest "a PSA mechanism *directly connected* to said reforming mechanism for removing impurities from said reformed gas to refine said reformed gas into said fuel gas," as recited in claim 4. The Hirata reference is silent on the subject matter of a pressure-swing adsorption (PSA) mechanism, and thus fails to teach or suggest a PSA mechanism *directly connected* to a reformer, as required by claim 4.

In light of the foregoing arguments, Applicants respectfully submit that the Burch and Hirata references, even if combined, do not teach or suggest each and every element of independent claim 4. Claim 7 depends upon claim 4 and adds separate and patentable limitations to claim 4. As such, for this and the reasons set forth above, Applicants respectfully submit that the dependent claim defines over the art of record.

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CONCLUSION

In view of the foregoing amendments and arguments, Applicants believe the pending application is in condition for allowance.

Applicants believe that no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. TOW-067 from which the undersigned is authorized to draw.

Dated: April 26, 2007

Respectfully submitted,

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